NASA SBIR Select 2012 Phase I Solicitation

E1.03 International Space Station Utilization

Lead Center: JSC

Participating Center(s): ARC, GRC, KSC, MSFC

NASA is investigating the near- and mid-term development of highly-desirable systems and technologies that provide innovative ways either to leverage existing ISS facilities for new scientific payloads or to provide on orbit analysis to enhance capabilities. Current utilization of the ISS is limited by available upmass, downmass, and crew time as well as by the capabilities of the interfaces and hardware already developed. Innovative interfaces between existing hardware and systems, which are common to ground research, could facilitate both increased, and faster, payload development. Technologies that are portable and that can be matured rapidly for flight demonstration on the International Space Station are of particular interest. Desired capabilities include, but are not limited to, the below examples:

- Providing additional on-orbit analytical tools. Development of novel instruments for on-orbit analysis of plants, cells and small mammals are desired. Instruments to support studies of bone and muscle loss, multi-generational species studies and cell and plant tissue are desired. Providing flight qualified hardware that is similar to commonly used tools in biological and material science laboratories could allow for an increased capacity of on-orbit analysis thereby reducing the number of samples which must be returned to Earth. Examples of tools that will reduce downmass or expand on-orbit analysis include: a mass spectrometer; an atomic force microscope (for biological and material science samples), non-cryogenic sample preservation systems; autonomous in-situ bioanalytical technologies; microbial and cell detection and identification systems; and fluidics and microfluidics systems to allow autonomous on-orbit experimentation and high throughput screening.
- Technologies are desired to ensure that microbial content of the air and water environment of the crew habitat falls within acceptable limits and life support system is functioning properly and efficiently. Required technology characteristics include: 2 year shelf-life; functionality in microgravity and low pressure environments (~8 psi). The technologies require significant improvements in miniaturization, reliability, life-time, self-calibration, and reduction of expendables. Microbial Analysis should cover identification and quantification.
- Providing a Magnet Processing Module (MPM) to enable materials research aboard ISS. Development of a Magnet Processing Module (MPM) for installation and operations in the Materials Science Research Rack (MSRR) would enable new and improved types of materials science investigations aboard the ISS. Essential components of the MPM include an electromagnet, which can provide a field strength up to 0.2 Tesla and a high temperature insert, which can provide directional solidification processing capability at temperatures up to 1500 °C. Efforts should focus on development of the following:
- An electromagnet that can generate the required field with the following properties:
    - Two coils each receiving 120 Vdc @ 10A (power consumption /= 184 mm.
    - Length = 239 mm.
    - Heat dissipation via liquid coolant loop.
    - Shielding to limit emissions to 3.16 Gauss at a distance measured 70 mm from the outer surface of

the magnet.

- A high temperature insert with a maximum outer diameter < 184 mm that is capable of processing a sample 26 mm (diameter) by 200 mm (length) in a partial vacuum environment of 0.7 Pa . Areas to be addressed include:
    - The number of zones (hot, cold, gradient) required for processing.
    - Heating elements vs. power consumption.
    - Selection and placement of insulations.
    - Selection, type, quantity, and placement of temperature measuring devices suitable for the operating temperature range. Adjustable autonomous control software that supports safe operation with low-bandwidth, intermittent command communication loop with varying latencies > 10 sec.

Proposals may address any one or a combination of the above or related subjects. The existing hardware suite and interfaces available on ISS may be found at the following link: (http://www.nasa.gov/mission_pages/station/science/experiments/Discipline.html). For all above technologies, research should be conducted to demonstrate technical feasibility and prototype hardware development during Phase I and show a path toward Phase II hardware and software demonstration and delivering an engineering development unit or software package for NASA testing at the completion of the Phase II contract that could be turned into a flight unit with minimal additional investment.*Phase I Deliverables* - Written report detailing evidence of demonstrated prototype technology in the laboratory or in a relevant environment and stating the future path toward hardware and software demonstration on orbit. The technology concept at the end of Phase I should be at a TRL of 5-6.*Phase II Deliverables* - Emphasis should be placed on developing and demonstrating hardware and/or software prototype that can be demonstrated on orbit (TRL 8), or in some cases under simulated mission conditions. The proposal shall outline a path showing how the technology could be developed into mission-worthy systems. The contract should deliver an engineering development unit for functional and environmental testing at the completion of the Phase II contract.